

# IEA Ocean Energy Systems Implementing Agreement & EC Co-Ordinated Action Project on Ocean Energy

Gouri Bhuyan, Ph.D., P.Eng.  
Powertech Labs Inc  
[www.powertechlabs.com](http://www.powertechlabs.com)

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# Past & Present Activities at Powertech Relevant to Ocean Energy

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- ✚ Monitored the World Progress for BC Hydro Since 1990
- ✚ Carried out Wave Energy Resource Assessment for Vancouver Islands, BC in 1995
- ✚ Assessed Relevant Technologies for BC Hydro in 2000, and Involved in the Selection of Technologies for the BC Hydro's Joint Venture Wave Energy Projects for VI
- ✚ Developed Acceptance Criteria to Ensure the Power Quality from a Wave Energy Plant
- ✚ Performing Various Tasks for the Pearson-EnCana-Clean Current Tidal Current Demonstration Project.
- ✚ Member of Several Consortium Teams Planning for Wave and Tidal Current Projects
- ✚ Represents Canada at the ExCo. of the IEA Implementing Agreement on Ocean Energy Systems Since 2002
- ✚ Partner of the EC- Coordinated Action project and responsible for a task on Integration of OE with Other Renewables and for Hydrogen production

## Scope of the Presentation

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-  IEA-IA-OES and Scope of Annexes
-  EC – Coordination Project on OE

# IEA-Implementing Agreement on Ocean Energy Systems (IA-OES)- Objectives

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- ✚ Encourage & support ***development of networks*** of participants for R&D, prototype testing and deployment , provide ***exchange of information*** on ocean energy.
- ✚ Promote development & utilization of ***technologies*** for enhanced sustainable energy production from the ocean.
- ✚ Promote involvement of industry.
- ✚ Promote interactions with other global, multilateral and national energy implementation programmes.

## IEA-IA-OES

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- ✚ Established in 2000 with the initiatives of UK, Portugal, Denmark, and EC
- ✚ Canada joined in 2002

## IEA IA-OES- Contracting Parties - 2005

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- Members:**
-  Denmark : Ministry of Economic and Business Affairs, Danish Energy Authority
  -  Portugal: National Institute of Industrial Technologies and Engineering (INETI)
  -  United Kingdom : Department of Trade and Industries
  -  European Commission
  -  Ireland: Sustainable Energy Ireland
  -  Japan: Saga University/JAMSTEC
  -  Canada : Powertech Labs
  -  USA : Department of Energy
- Observers:**
-  Italy, Norway, Brazil, Australia, France, Belgium

## **Annex I**

### **Review, Exchange and Dissemination of Information on OES**

Operating Agent

INETI acting through ADENE ( Portuguese  
Energy Agency) .

## **Annex II**

### **Development of Recommended Practices for Testing and Evaluating OES**

Operating Agent

Ministry of Economic and Business Affairs,  
Danish Energy Authority acting  
through RAMBOLL, Denmark

# Annex I – Review, Exchange and Dissemination of Information on OES

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## WORK DONE

- Two resources, marine current and ocean wave
- Collation of the information available on the
  - resource
  - technology
  - demonstration plants
  - development status
  - economics and environmental impacts
- Assessment of the R&D issues
- Consultation with over 100 interested parties including majority of developers worldwide

## **Annex II – Objective & Work Done**

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- ✚ To develop guidelines that could become standards for:
  - ✚ Testing Procedures
  - ✚ Preliminary cost estimate
  - ✚ Presentation of results
  
- ✚ Need broad agreement on how model testing and performance assessment of a prototype are conducted





# Open Sea vs Controlled Environment Testing

## ***Controlled Testing***

-  Developer
-  Collaborator

- Efficiency
- Configuration
- Technology selection





## ***Open Sea Testing***

-  Developer
-  Investor
-  Insurer
-  Manufacturer

- Economics
- Reliability
- Maintainability

## Model Tests - Challenges

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-  Scale-up issues
-  Generation of realistic time series of waves
-  Wave shapes to match open sea
-  Implications of test facilities

# Open Sea Performance Assessment - Challenges

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- ✚ Making the performance assessment as site-independent as possible
- ✚ Parameters for the energy curve

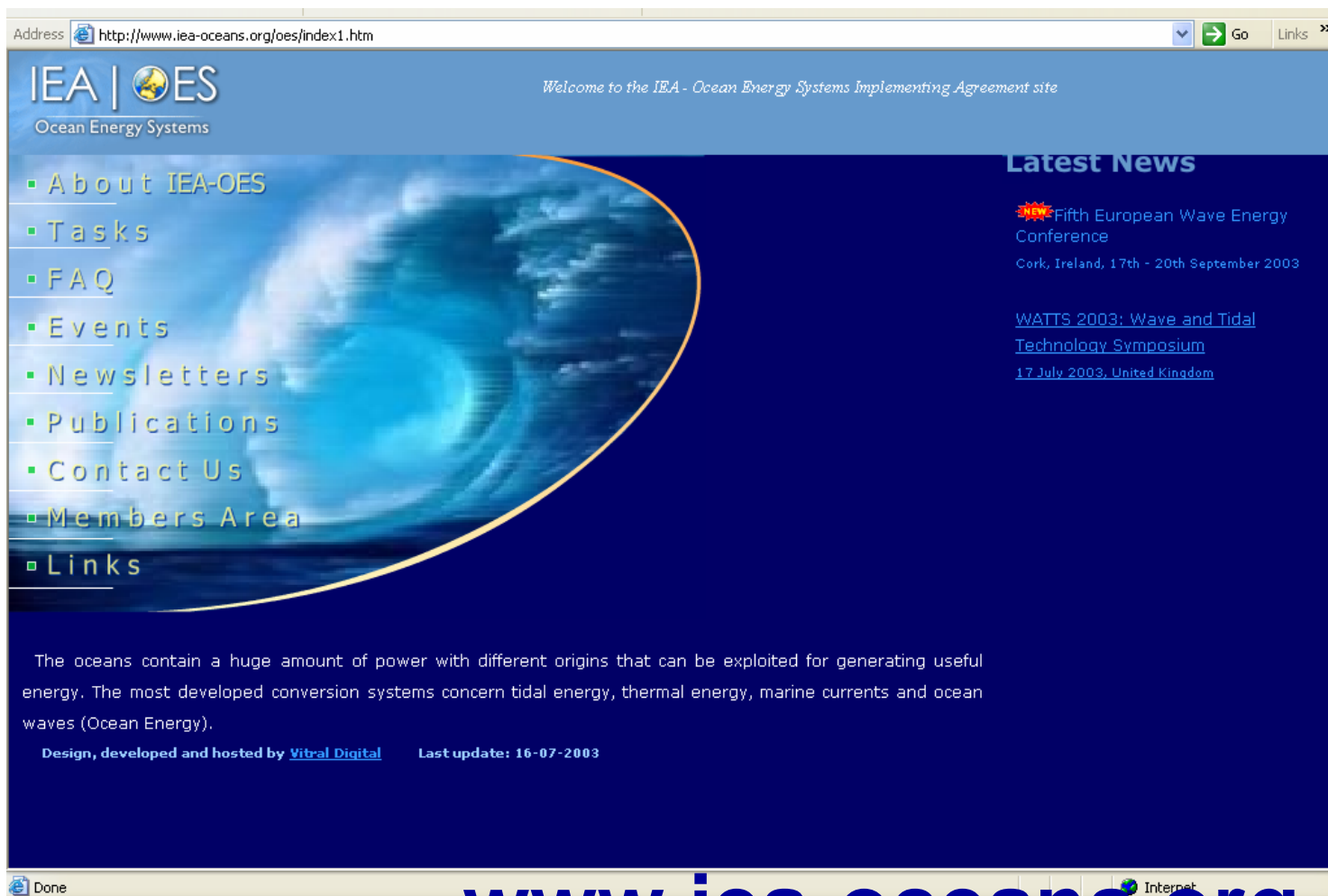
## Proposed Topics for New Annexes




- ✚ Extension of the Annex II on Development of Guidelines for Performance Assessment & Assessment of Energy Cost
- ✚ Standardize Resource Atlas, Including Offshore Wind
- ✚ Development of Design Standard for Environmental Acceptance
- ✚ Power Reliability, Quality, and Integration

## **Next Meetings of the IEA-IA-OES**

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- ✚ Brussels, November 16-17, 2005, in Conjunction with the EU Conference on Communicating Research, Nov. 14-15
- ✚ Vancouver, May 1-2, 2006, In Conjunction with the Canadian National Symposium on Ocean Energy, Victoria, May 4-5, 2006




Address  <http://www.iea-oceans.org/oes/index1.htm>  Go  Links >>

**IEA | OES**  
Ocean Energy Systems

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### Latest News

 [Fifth European Wave Energy Conference](#)  
Cork, Ireland, 17th - 20th September 2003

[WATTS 2003: Wave and Tidal Technology Symposium](#)  
17 July 2003, United Kingdom

The oceans contain a huge amount of power with different origins that can be exploited for generating useful energy. The most developed conversion systems concern tidal energy, thermal energy, marine currents and ocean waves (Ocean Energy).




Design, developed and hosted by [Vital Digital](#) Last update: 16-07-2003

Done  Internet






[www.iea-oceans.org](http://www.iea-oceans.org)

## EC-CA Project - Objectives

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-  To develop a common knowledge base necessary for coherent development of R&D policies
-  To bring a coordinated approach within key areas of ocean energy research and development
-  To provide a forum for the longer term marketing of promising research deliverables

## **EU-CA Project Main Deliverables: Work Packages & Corresponding Workshops**

-  Modelling of Ocean Energy Systems- held at Aalborg Univ., April 2005.
-  Component Technology and Power Take-off
-  System Design, Construction, Reliability & Safety
-  Performance Monitoring of OES
-  Environmental, Economics, Development Policy and Promotion Opportunities

# Steps in the Development of a Ocean Energy Converter

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-  Basic conception
-  Theoretical/numerical modelling
-  Model testing in wave basin or flume
-  Engineering & prototype testing in real sea

## Experimental Modelling

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- ✚ Phase 1 - Validation model – fundamental testing in regular waves
- ✚ Phase 2 – Validation and design model – testing in realistic sea conditions
- ✚ Phase 3 – Design of process model – testing in conditions representative of deployment site
- ✚ Phase 4 – Process model – Large scale demonstration plant in sea
- ✚ Phase 5 – Prototype & Construction model – pre-production prototype

# Energy Transformation Chain

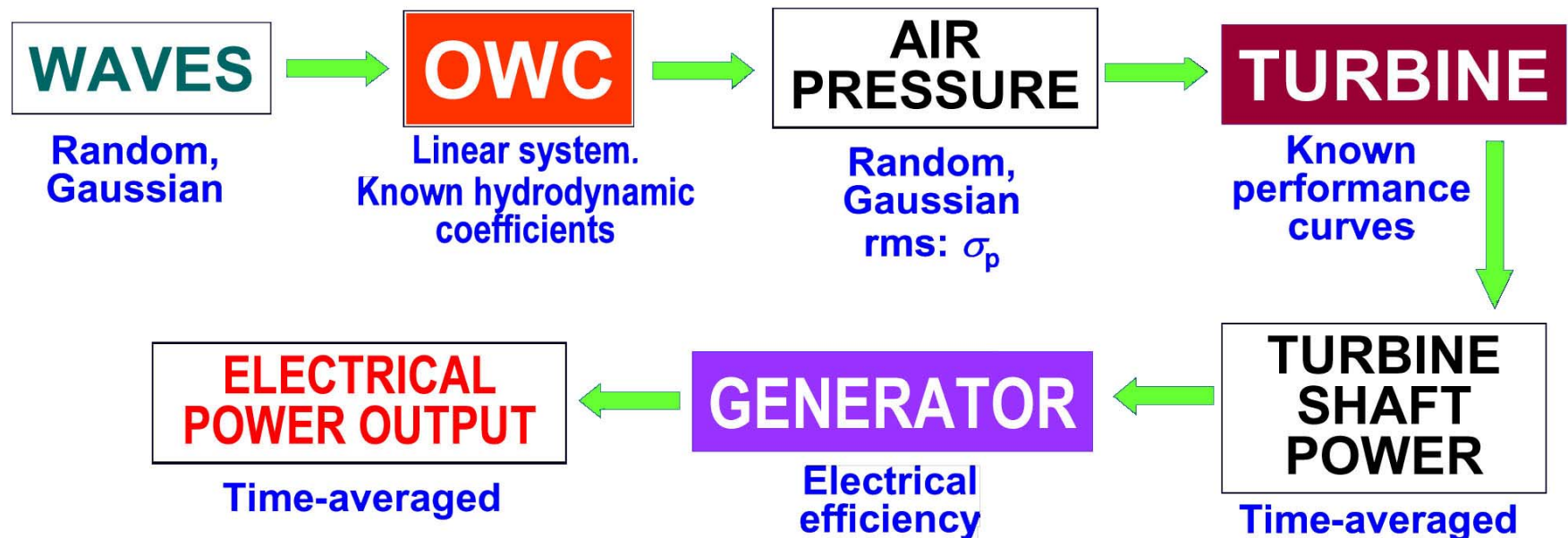
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- ✚ Offshore climate
  - local climate
- ✚ Wave/Tidal Current/device interaction (primary conversion)
- ✚ Secondary energy conversion
- ✚ *Intermediate energy storage* (option)
- ✚ Power Take Off mechanism
- ✚ Electricity generation
- ✚ Grid connection

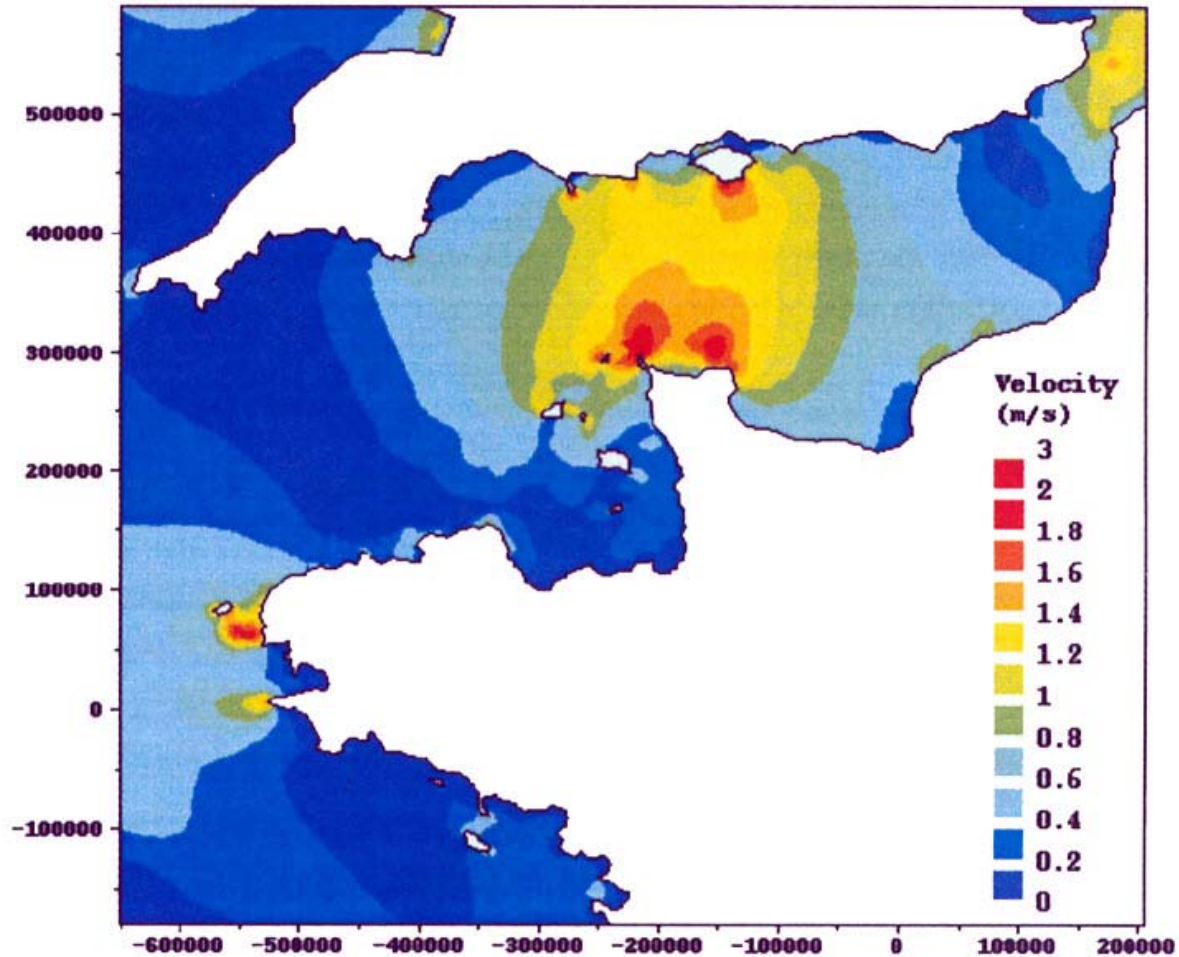
## Stochastic model

### Wave climate represented by a set of sea states

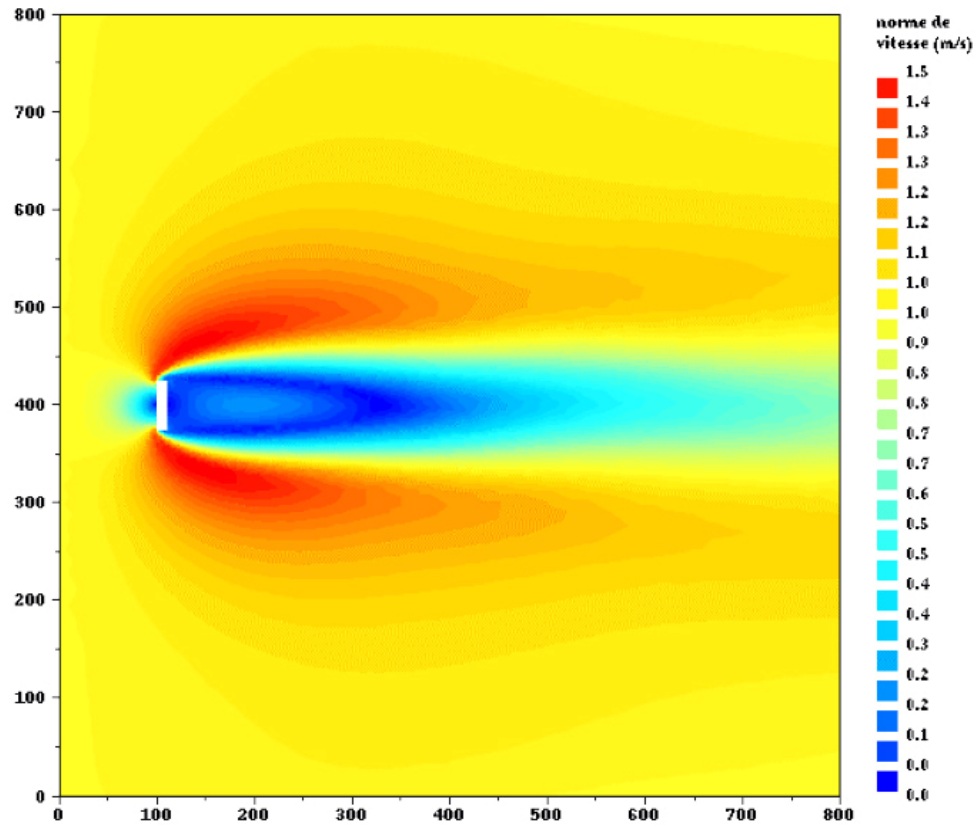
- For each sea state:  $H_s$ ,  $T_e$ , freq. of occurrence  $\phi$ .
- Incident wave is random, Gaussian, with known frequency spectrum.



# Numerical modelling of tidal current resources by EDF – Telemac- 2D FE code

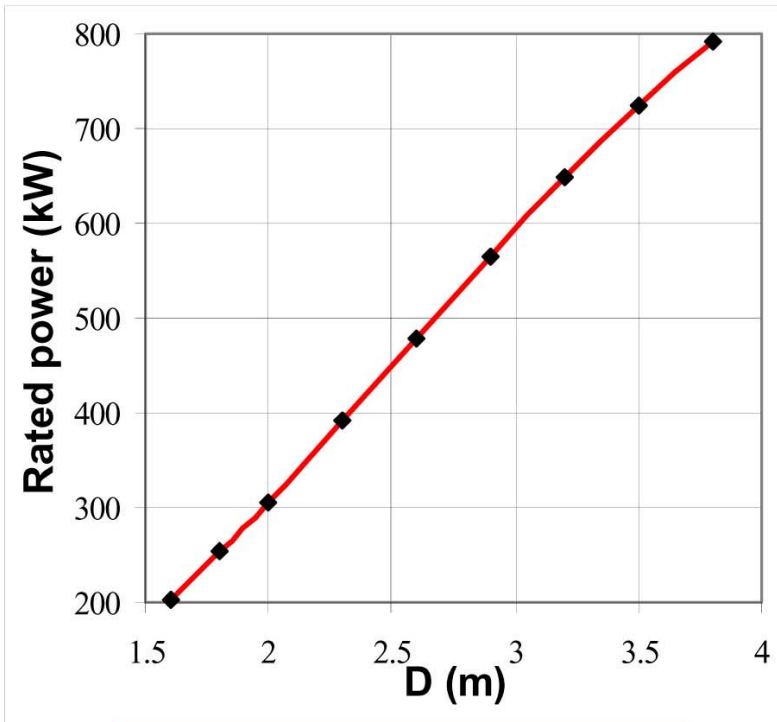


# Modelling Current and Converters

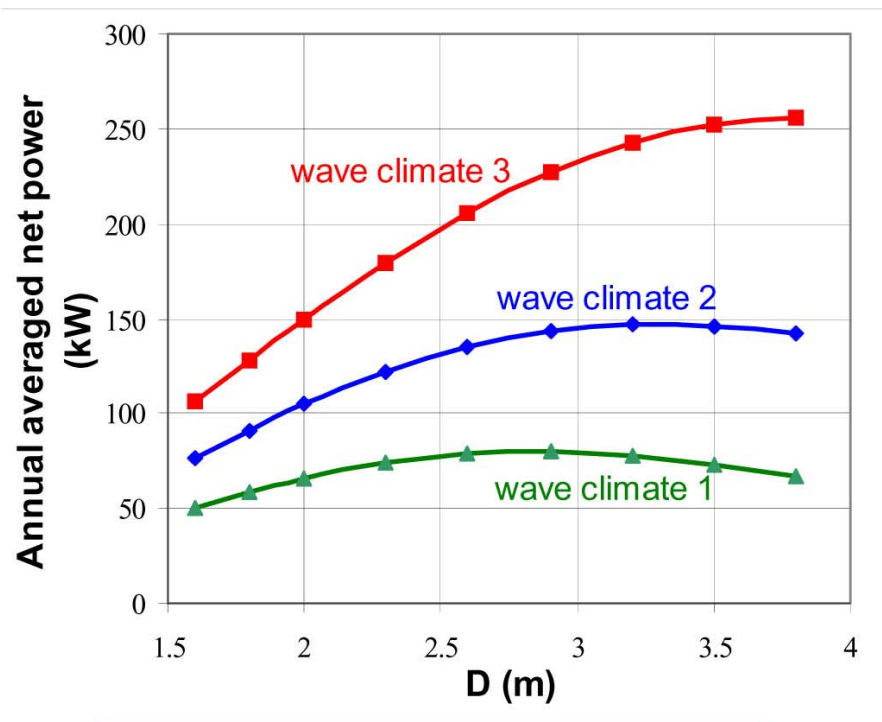


# Application of stochastic model

**Wells turbine size range  $1.6\text{m} < D < 3.8\text{m}$**

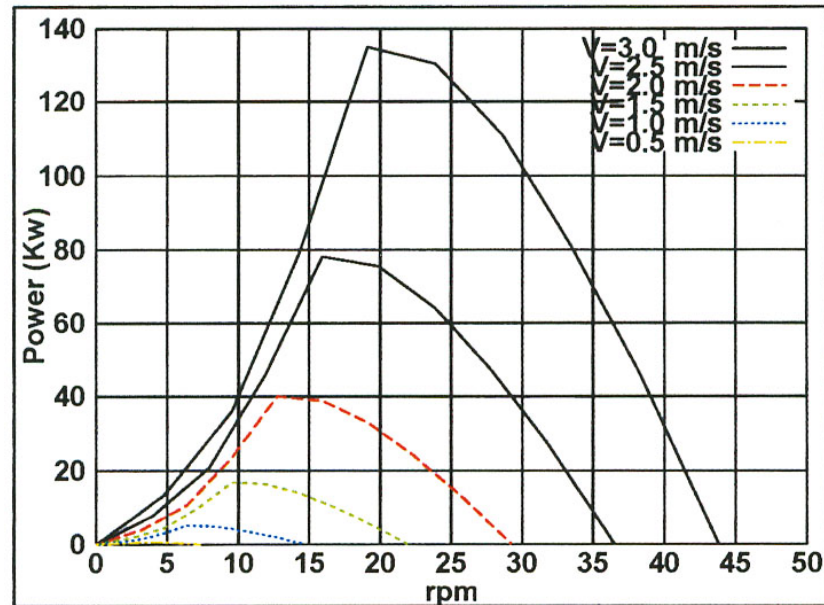


Plant rated power  
(for  $H_s = 5\text{m}$ ,  $T_e = 14\text{s}$ )



Annual averaged net power (electrical)

# Numerical prediction of Performance- Enermer Tidal Current Demo Plant



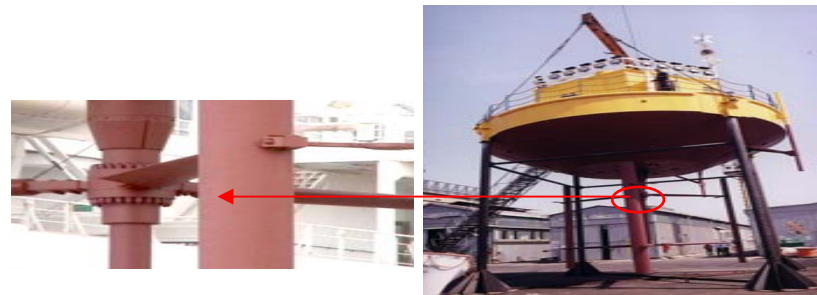
Turbine rev: 18 rpm max

Synchronous generator (3-phase): 120 kW at 1500 rpm

Electrical load: 60 X 1 kW


PERFORMANCES

Numerical previsions



## **Next Workshop of the EC-CA-OE**

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-  On Power Take Off, Swedish Renewable Energy Centre, Uppsala University, Nov. 2-3, 2005

***Thank You***  
***For more information, please visit***  
***[www.iea-oceans.org](http://www.iea-oceans.org)***  
***[www.powertechlabs.com](http://www.powertechlabs.com)***